# Advanced Radioisotope Power Sources for Future Deep Space Missions

By Erik N. Nilsen
Member of the Technical Staff
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109
Erik.N.Nilsen@jpl.nasa.gov

## Abstract

The use of Radioisotope Thermoelectric Generators (RTGs) has been well established for deep space mission applications. The success of the Voyager, Galileo and Cassini missions proved the efficacy these technologies in deep space. Future deep space missions must also rely on the availability of Advanced Radioisotope Power Supply (ARPS) technologies to accomplish their goals.

In the Exploration of the Solar System (ESS) theme, several missions are in the planning stages or under study that are enabled by ARPS technology. Two ESS missions in the planning stage may employ ARPS. The Europa Orbiter mission (EO) will perform a detailed orbital exploration of Jupiter's moon Europa to determine the presence of liquid water under the icy surface. An ARPS system based upon Stirling engine technology is currently baselined for this mission. The Pluto Kuiper Express mission (PKE) to study Pluto, its moon Charon, and the Kuiper belt, is scheduled to use the Cassini spare RTG. However, if this unit is unavailable for this mission, ARPS technologies will be required.

Future missions under study will also require ARPS technologies. Mission studies are now underway for a detailed exploration program for Europa, with multiple mission concepts for landers and future surface and subsurface explorers. For the orbital phase of these missions, ARPS technologies will provide the necessary power for the spacecraft and orbital telecommunications relay capability for landed assets. For extended surface and subsurface operations, ARPS may provide the power for lander operations and for drilling.

Other missions under study will need ARPS technologies. Saturn Ring Observer (SRO) will perform a detailed study of Saturn's rings and ring dynamics. The Neptune Orbiter (NO) mission will perform a detailed multi disciplinary study of Neptune. Titan Explorer (TE) will perform in-situ exploration of Saturn's moon Titan, with both orbital operations and landed operations enabled by ARPS technologies. All of these missions are enabled by ARPS technology.

This paper presents the current status of ongoing studies of future ESS mission concepts and the design assumptions and capabilities required from ARPS technologies. Where specific capabilities have been assumed in the studies, the results are presented along with a discussion of the implementation alternatives.